

Issue No : 2
Issue Date : March 2009
Project No. : 876

**AIR VENTILATION ASSESSMENT
FOR REDEVELOPMENT OF KWUN
TONG SWIMMING POOL COMPLEX
AND KWUN TONG RECREATION
GROUND - EXPERT EVALUATION**

Report Prepared by :
Allied Environmental Consultants Ltd.

COMMERCIAL-IN-CONFIDENCE

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AIM

To qualitatively evaluate the proposed design to advise any adverse effect on wind environment caused by the building structure to immediate local area.

SUMMARY

As the proposed redevelopment of Kwun Tong Swimming Pool Complex is located within an open space, an air ventilation assessment is required in accordance with Technical Circular No. 1/06 Air Ventilation Assessment. An expert evaluation (EE) was carried out to evaluate the air ventilation condition of the surrounding environment in relation to the proposed redevelopment.

Prevailing wind directions and wind corridors were identified in this EE. The existing urban setting and possible changes in ventilation environment due to the proposed development were discussed. No major air ventilation problem is found. However possible localized ventilation issue at Lei Yue Mun Road during non-summer period where prevailing wind is from northeast was identified. In consideration of site constraints and practical use of proposed facilities, the proposed Complex was designed to minimize the impact on air ventilation where minimum height of outdoor pool and a void of 3m vertical clearance under the outdoor pool deck are incorporated to allow air ventilation. An air pathway is recommended at the crush hall of the proposed Complex to allow prevailing winds from southwest and northeast flowing through the proposed complex at pedestrian level.

In general the proposed complex will have little specific wind problem. There will be no major air ventilation issue. Therefore, further study is not necessary.

1. Introduction

In accordance with Technical Circular No. 1/06 Air Ventilation Assessment jointly issued by Housing, Planning and Lands Bureau and Environment, Transport and Works Bureau, proponent departments / bureaux or authorities should assess the need to apply Air Ventilation Assessment (AVA) to some categories of major government project during the planning stage. The redevelopment of Kwun Tong Swimming Pool Complex falls within the category of “*Buildings with height exceeding 15metres within a public open space or breezeway designed on layout plans / outline development plans / outline zoning plans or proposed by planning studies*”. Allied Environmental Consultants Limited (AEC) has been appointed by the project architect, Ronald Lu and Partners (Hong Kong) Ltd. to undertake an air ventilation assessment for the redevelopment of Kwun Tong Swimming Pool Complex.

During the preliminary design stage, an Expert Evaluation (EE) was carried out to evaluate the air ventilation impacts of the proposed redevelopment on the pedestrian wind environment. The purpose of EE are to identify good design features, any potential problem areas, mitigation measures and determine if further study should be carried out at later stage. This report presented the proposed development layout and details of EE.

1.1 Background

The subject site is at the junction of Lei Yue Mun Road and Tseung Kwan O Road. It is surrounded by institutions on the west, residences on the north, governmental infrastructures (e.g. Kwun Tong Magistracy, Government Offices and Kwun Tong Police Station), commercial and industrial centers on the south as shown on **Figure 1**. The total redevelopment area is around 3.9 hectares. The proposed Swimming Pool Complex will comprise the following facilities to be managed by Leisure and Cultural Services Department (LCSD):

- (i) Redevelopment of KTSPC at existing soccer pitches in KTRG comprising the following facilities:
 - One 50.03m x 25m indoor heated main pool in 8 lanes with uniform water depth of 2m, with spectator stand having a seating capacity of 1500
 - One indoor 30m x 25m indoor heated training pool in 12 lanes with uniform water depth of 1.2m
 - One 50 x 21m outdoor secondary pool in 8 lanes with water depth of 1.4m at the middle and 1.1m at both ends

- Two 25m x 12.5m outdoor teaching pools in 5 lanes with water depth 0.83m sloping to 1.1m
 - A sun bathing area
 - Other ancillary including shroff office, pool management office, changing rooms and toilets
- (ii) Reprovisioning of the existing facilities in KTRG at the location of the existing KTSPC and the north-eastern part of the existing KTRG comprising the following facilities:
- One 7-a-side standard artificial turf soccer pitch
 - Two 7-a-side mini-soccer pitches with colour floor coating
 - Three basketball courts cum volleyball courts
 - One roller skating rink
 - Two children's play areas
 - Walkways and jogging trail with provision of elderly fitness corners
 - Contemporary-designed garden with sitting-out areas and rain shelters/pavilions
 - Service building with management office, staff roll call point room, store rooms, first-aid room, meter room, refuse collection chamber, dangerous goods store and loading/ unloading space, etc.
 - Toilet block cum changing room
- (iii) Incorporation of a new Kwun Tong District Leisure Service Office in the new KRSPC.

The overall dimensions of the building are about 177m (along the east and west edges) x 72m (along north and south edges) x 24m (absolute roof height of indoor pool hall above ground). *Figures 2a-2d* show the development layout plans.

2 Site Wind Availability Data

Both weather data provided by Hong Kong Observatory and Mesoscale Model (MM5) published in the website of Planning Department are acceptable for assessment, as

recommended in “*Technical Guide for Air Ventilation Assessment for Developments in Hong Kong*” published by Housing, Planning and Lands Bureau (HPLB) and Environment, Transport and Works Bureau (ETWB).

2.1 Wind Data from Hong Kong Observatory

There are two weather stations operated by Hong Kong Observatory (HKO) near the subject site. Tseung Kwan O weather station is located at about 2km from subject site where Kai Tak weather station is located at about 1km from subject site. **Plate 1** shows the location of weather stations operated by HKO in Hong Kong.

Plate 1 Location of weather stations in Hong Kong



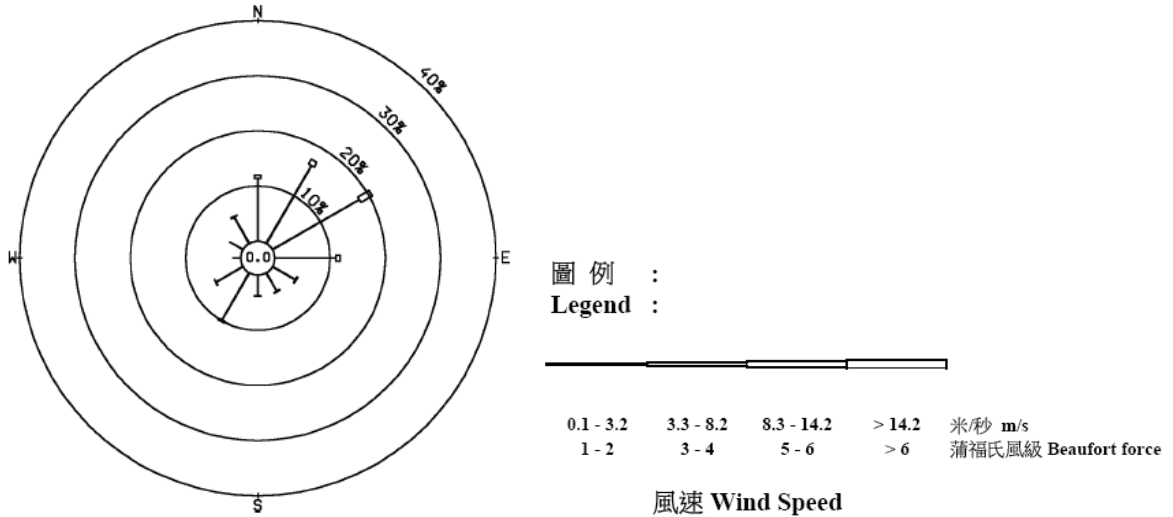
2.1.1 Tseung Kwan O Weather Station

The frequencies of occurrence of each wind direction throughout a year was estimated with reference to Site Wind Availability Data of Tseung Kwan O annual wind rose data in 2007, obtained from the Hong Kong Observatory (HKO) and shown in **Plate 2**. Wind would mostly come from north-east sector throughout a year whereas in summer (Jun – Aug), wind from south-west section also attributes a significant portion other than that from north-east section.

The mean speed measured at HKO Tseung Kwan O Anemometer is around 6.6km/hr according to the Summary of Meteorological and Tidal Observations in Hong Kong 2007. The most prevailing wind direction is East-North-East.

Plate 2 Tseung Kwan O Annual Wind Roses (2007)

將軍澳 Tseung Kwan O



Detailed wind availability data is available from the Tseung Kwan O weather station. The wind direction and frequency of occurrence in different months are tabulated in **Table 1**.

Table 1 Site Wind Availability Data of Tseung Kwan O, HKO, Jan-Dec 2007

Wind Direction	Frequency of Occurrence (Dec – Feb)	Frequency of Occurrence (Mar – May)	Frequency of Occurrence (Jun – Aug)	Frequency of Occurrence (Sep – Nov)
N	12.1%	9.8%	0%	14.3%
NNE	35.2%	19.5%	2.8%	19.8%
NE	3.3%	1.2%	0%	4.4%
ENE	31.9%	26.8%	2.8%	33.0%
E	12.1%	0%	8.5%	9.9%
ESE	0%	0%	7.0%	0%
SE	0%	1.2%	7.0%	0%
SSE	0%	2.4%	0%	2.2%
S	1.1%	3.6%	5.6%	1.1%
SSW	1.1%	19.5%	40.8%	2.2%
SW	0%	0%	12.7%	1.1%
WSW	0%	2.4%	11.3%	1.1%
W	0%	0%	0%	0%
WNW	0%	0%	0%	3.3%
NW	0%	0%	0%	0%
NNW	0%	0%	1.4%	2.2%

The wind data from HKO reveals the wind pattern during summer and non-summer periods. In *Table 1*, the pattern of wind availability from June to August (summer) is apparently different from the other three periods. A higher probability of South-South-West (SSW) wind is indicated in summer, while the other columns show low probability of SSW wind. Therefore, SSW wind is the most prevailing wind direction in summer. For the non-summer period, the columns of Dec-Feb, March-May, Sep-Nov show East-north-east is the most prevailing wind direction.

2.1.2 Kai Tak Weather Station

The anemometer of Kai Tak Weather Station is located at the apron at open sea area. The prevailing wind direction is from ESE. *Plate 3* shows the annual wind rose of Kai Tak Weather Station. The recorded mean wind speed was 12.3km/hr annually. This is likely due to the exposed surrounding of the weather station. The wind direction and frequency of occurrence in different months are tabulated in *Table 2*.

Due to the hilly topography at both sides of Lei Yue Mun, southeasterly wind passes through the Lei Yue Mun channel without much obstruction and reaches the inner Victoria Harbour area. As both sides of the Victoria Harbour near the Kai Tak station are densely populated with high-rise buildings and mountainous features on Hong Kong Island, wind from other directions are likely dissipated or obstructed. Thus wind flow through Lei Yue Mun channel is predominately the major wind direction at this weather station.

Plate 3 Kai Tak Annual Wind Roses (2007)

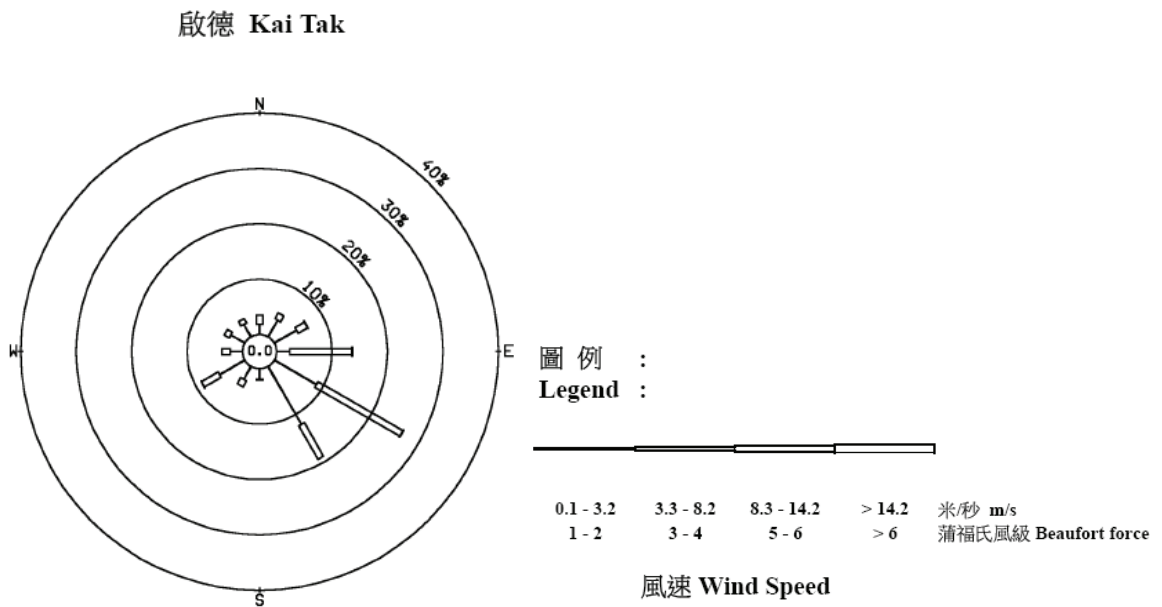


Table 2 Site Wind Availability Data of Kai Tak, HKO, 2007

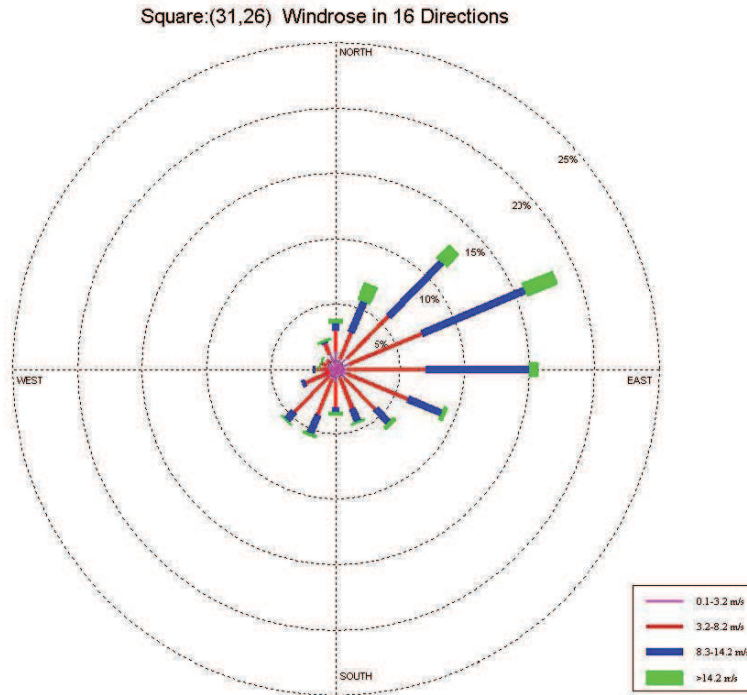
Wind Direction	Frequency of Occurrence
N	3.8%
NNE	4.6%
ENE	6.4%
E	14.7%
ESE	27.8%
SSE	19.2%
S	2.3%
SSW	3.8%
WSW	9.3%
W	3.8%
WNW	4.7%
NNW	3.8%

2.2 Wind Data from MM5

The assumption of wind data refers to the “Site Wind Availability Data” published by the Planning Department which is simulated by Fifth-Generation NCAR/ Penn State Mesoscale Model (MM5). *Plate 4* shows the annual wind rose of Grid (31,26) which is the nearest grid to the subject site. It indicates wind velocity ranges from 0 to 22m/s from 16 wind directions at 596m above the terrain level. The eight most probable wind directions which

exceed 75% of a year at this grid are summarized in *Table 3* and the wind velocity was summarized in *Table 4*.

Plate 4 Wind Rose of Grid (31, 26), MM5



Note: Height of wind rose resolved is 596mPD.

Table 3 Summary of the MM5 Wind Data for Grid (31, 26) of a Year

Prevailing Wind Direction	Degree of Wind Direction	Probability
N	0°	3.8%
NNE	22.5°	6.9%
NE	45°	12.8%
ENE	67.5°	18.2%
E	90°	15.4%
ESE	112.5°	9.0%
SE	135°	5.9%
SSE	157.5°	4.4%
S	180°	3.4%
SSW	202.5°	5.4%
SW	225°	5.5%

Prevailing Wind Direction	Degree of Wind Direction	Probability
WSW	247.5°	2.8%
W	270°	1.7%
WNW	292.5°	1.3%
NW	315°	1.0%
NNW	337.5°	2.4%

Table 4 Summary of the Wind Velocity of the 8 Most Probable Wind Directions

Velocity infinity (m/s)	NNE	NE	ENE	East	ESE	SE	SSW	SW
0 to 1	0.001	0.001	0.001	0.002	0.001	0.002	0.001	0.001
1 to 2	0.004	0.003	0.003	0.001	0.003	0.003	0.002	0.003
2 to 3	0.003	0.005	0.005	0.005	0.004	0.004	0.004	0.003
3 to 4	0.006	0.011	0.009	0.008	0.007	0.006	0.006	0.006
4 to 5	0.004	0.01	0.013	0.01	0.007	0.006	0.005	0.007
5 to 6	0.003	0.009	0.011	0.012	0.01	0.006	0.007	0.008
6 to 7	0.002	0.007	0.014	0.013	0.013	0.008	0.006	0.008
7 to 8	0.005	0.011	0.012	0.015	0.012	0.007	0.006	0.008
8 to 9	0.005	0.008	0.015	0.015	0.011	0.005	0.005	0.005
9 to 10	0.005	0.008	0.012	0.018	0.01	0.004	0.005	0.001
10 to 11	0.006	0.011	0.013	0.02	0.005	0.003	0.003	0.001
11 to 12	0.003	0.012	0.017	0.016	0.002	0.002	0.001	0.002
12 to 13	0.004	0.011	0.018	0.01	0.001	0.001	0.002	0
13 to 14	0.003	0.007	0.013	0.004	0.001	0	0	0
14 to 15	0.003	0.007	0.01	0.003	0	0	0	0
15 to 16	0.002	0.002	0.005	0.002	0	0.001	0	0
16 to 17	0.002	0.002	0.003	0.001	0	0	0	0
17 to 18	0.003	0.001	0.002	0	0	0	0	0
18 to 19	0.001	0.001	0.001	0	0	0	0	0
19 to 20	0.002	0.001	0	0	0.001	0	0	0
20 to 21	0.001	0.001	0.001	0	0	0	0	0
21 to 22	0	0.001	0.001	0	0	0	0	0
22 to 23	0	0	0.002	0	0	0	0	0

The mean speed predicted at the nearest grid by MM5 is around 7.457m/s according to the

provided wind speeds and wind probabilities. The most prevailing wind direction is of East-North-East.

2.3 Wind Availability at Subject Site

With reference to wind data from Tseung Kwan O Weather Station, Kai Tak Station and the MM5 data, the prevailing winds for the subject site may come from NE, SW and SE. these stations demonstrated prevailing wind from ENE. Wind from ESE with reference to Kai Tak Weather Station is another major wind component entering the Kwun Tong Area. Thus, most prevailing wind directions from ENE in non-summer and SSW in summer period according to Tseung Kwan O Weather Station and MM5 data, and wind from ESE according to Kai Tak Weather Station are adopted in this expert evaluation.

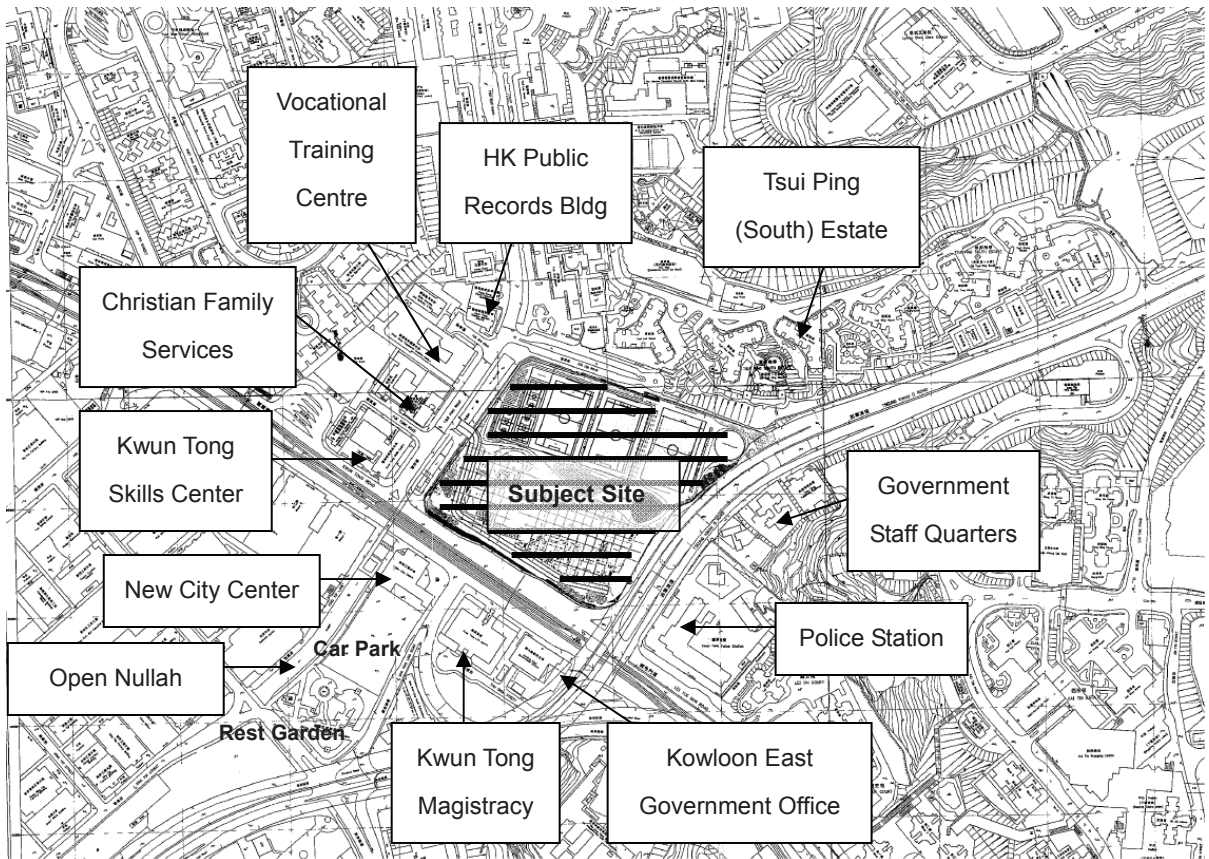
3. Existing Wind Environment

3.1 Surrounding Environment

The proposed redevelopment area is located to the east of Kwun Tong Town Centre. It is situated to the northwest of the junction of Lei Yue Mun Road and Tseung Kwan O Road to the southeast. A number of road carriageways are located immediately adjacent to the development site. The site is bounded to the east by Tseung Kwan O Road, to the south by Lei Yue Mun Road and to the west by Tsui Ping Road. The street level around the subject site area ranges from 5.8mPD to 6.6mPD which is a flat area. The subject site locates on elevation of approximately 6.2mPD. There are elevated ramps at Tseung Kwan O Road adjoining Kwun Tong Bypass through Wai Fat Road. MTR viaduct is above Lei Yue Mun Road and Kwun Tong Road. *Figure 1* shows the location of subject development and surrounding major roads.

The adjacent land is predominantly residential and government / institute / community (GIC) use. It is surrounded by medium to high-rise buildings such as Tsui Ping South Estate and GIC developments including Kwun Tong Police Station, Kwun Tong Law Courts and Kwun Tong Vocational Training Centre. Industrial buildings are located to the west of the site at the opposite side of Lei Yue Mun Road. *Plate 5* below identified the nearby development and land use.

Plate 5 *Surrounding Environment of Subject Site*

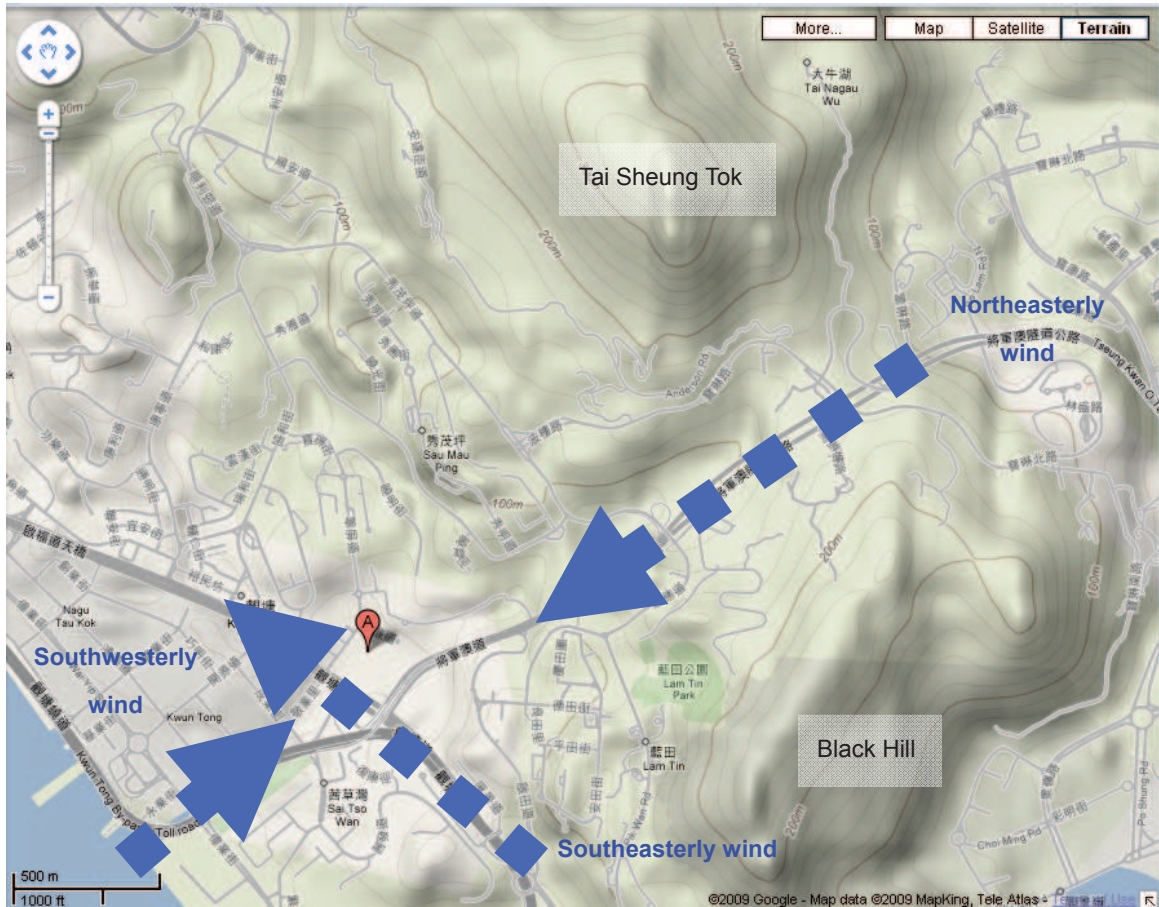


3.2 Identification of Air Paths / Wind Corridors

Wind from northeast is likely flown between Black Hill on the East and Tai Sheung Tok at the North of Kwun Tong and reaching the subject site. In consideration of the prevailing wind data recorded at Kai Tak Weather Station, wind flow from southeast passes through Lei Yue Mun channel and over Lam Tin, Cha Kwo Ling, Sai Tsoi Wan and Laguna City before reaching Kwun Tong district and the subject site.

The straight and wide Lei Yue Mun Road, Kwun Tong Road and Tseung Kwan O Road are major ventilation corridors allowing wind penetration into the Kwun Tong area. **Plate 6** below shows the annual prevailing winds through wind corridors.

Plate 6 Prevailing Winds through Wind Corridors



3.3 Existing Ventilation Condition

The GIC users (e.g. Police Station, Government Staff Quarters, Kwun Tong Magistracy, Vocational Training Centre, Christian Family Services Centre and Kwun Tong Skills Centre) at the east, south and west of subject site are low-rise buildings. As these buildings are low-rise structures, wind through the top of buildings could still reach the pedestrian level in a short distance. Significant wind obstruction is unlikely.

High-rise residential buildings at Tsui Ping (South) Estate are located at northeast of the subject site. As these buildings are separated without podium, air flow from north and northeast could still reach the recreation ground and existing Kwun Tong swimming pool which is a major open space within this area.

Tseung Kwan O Road lies along the prevailing north-easterly wind direction. The elevated ramps adjoin the Tseung Kwan O Road at grade near the junction at Lei Yue Mun Road and the east of Tsui Ping (South) Estate. Slight wind obstruction due to the elevated ramp at north bound may occur. However as wind penetration could be allowed from Tsui Ping (South) Estate, air ventilation problem is unlikely.

There is a rest garden and a car park at the southwest direction behind New City Centre. There is wind obstruction by the single building New City Centre during summer. Air flow is still allowed at both sides through open nullah next to King Yip Lane and Cha Kwo Ling Road to the pedestrian level of Lei Yue Mun Road. Wind flow pattern may slightly be altered due to the MTR viaduct above Lei Yue Mun Road. However wind flow at pedestrian level could still be allowed under the viaduct.

Prevailing southeasterly wind flows through Sceneway Garden and over Sai Tsoi Wan and Laguna City, and then reaches Kwun Tong District. Kwun Tong Road and Lei Yue Mun Road are wide and straight and will channel wind from the southeast towards the Kwun Tong area, which allows wind penetration into inner Kwun Tong District. Southeasterly wind may be diverted upward due to the building profile of industrial district, diverted to northeast and southwest directions along King Yip Street and King Yip Lane after hitting the building façade and possibly some downwash reaching King Yip Street and King Yip Lane.

4. Expert Evaluation

For the predominant wind directions, the interaction between the wind and the building morphology in the area was considered. Important features taken into account include the distances between the proposed building forms, their overall heights and bulk as well as the landform.

4.1 Prevailing Winds from Northeast

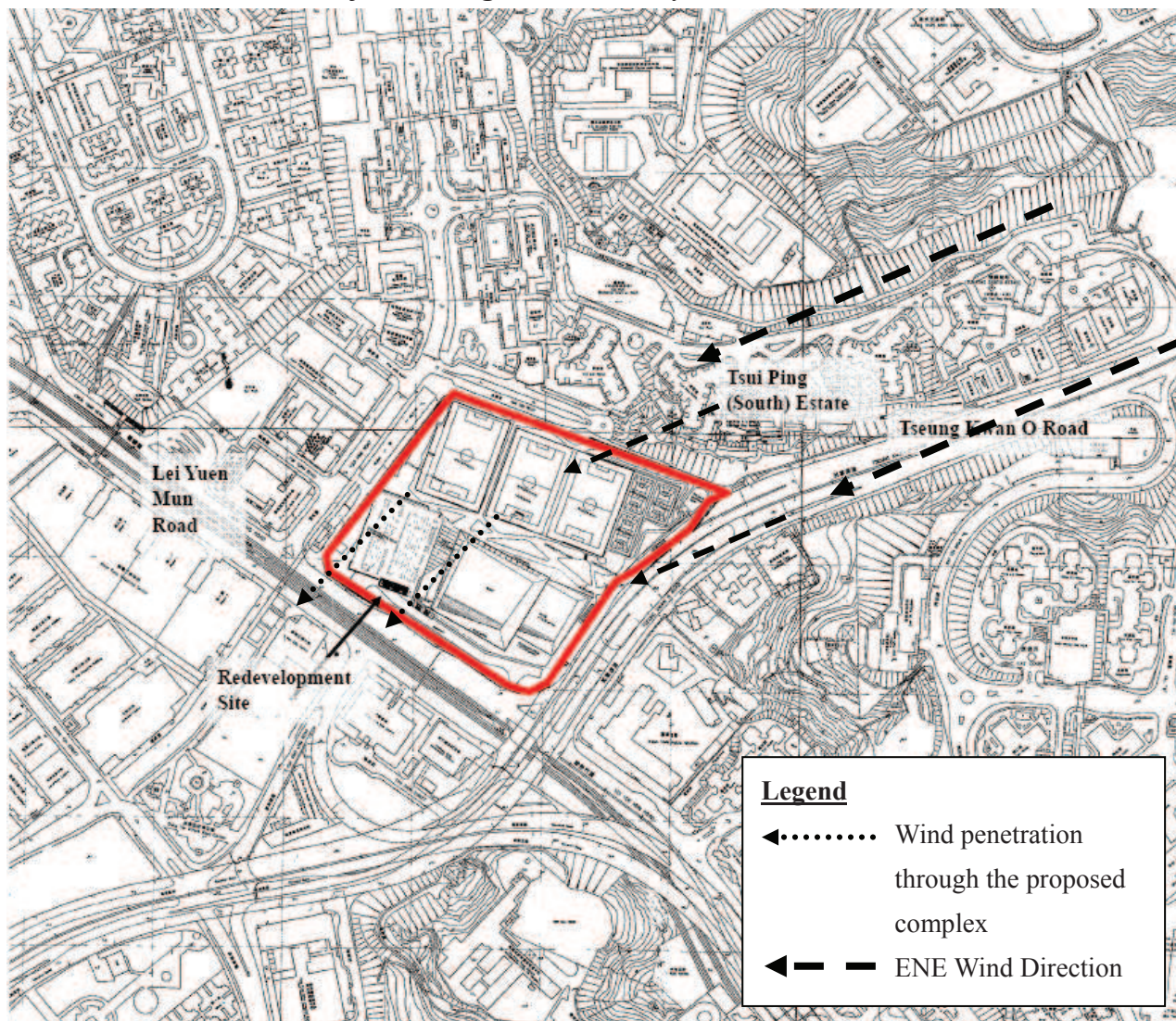
4.1.1 With reference to the wind data, prevailing north-easterly winds pass through the wind corridor between the Black Hill and Tai Sheung Tok and enter the subject site. The subject site is a flat land ranging from 5.8mPD to 6.6mPD without other natural screening. The proposed complex will be located at south-east of subject site. North-easterly winds penetrate through Tsui Ping (South) Estate, the future open space and the raised outdoor swimming pool deck to the south of subject site.

4.1.2 The covered pool hall section is located at the eastern half portion while the open pool deck is located at the western half portion of the proposed complex. The open pool deck level is low (at approximately 5.5m above ground) and a void of 3m vertical clearance is maintained below the outdoor pool deck as hard-paved landscape area. Section plan in **Figure 2e** shows the raised outdoor pool deck and the building span along Lei Yue Mun Road. In consideration of the low rise nature of the outdoor swimming pool deck, wind flow is still allowed passing through the void of 3m vertical clearance at the hard-paved landscape area and the top of outdoor pool deck and reaching Lei Yue Mun Road. Wind

penetration through the proposed complex could still be allowed.

- 4.1.3 Building height will be kept at a low-rise level (i.e. highest roof panel at 24m above ground), which harmonizes the nearby low rise buildings and is lower than the neighboring residential buildings at the north. Significant obstruction of prevailing wind flow by building height is not anticipated.
- 4.1.4 While the prevailing wind shall be diverted upward over the building height before reattached to the pedestrian level, localised wind problem may occur at Lei Yue Mun Road when prevailing wind is from northeast. The wind flow at Lei Yue Mun Road could be facilitated by provision of a more permeable structure at ground level of the proposed complex, such as ventilation path and wider void under the outdoor pool deck. An air pathway is recommended at the crush hall of the proposed Complex to allow wind flow from northeast to Lei Yue Mun Road. With the incorporation of this recommended air pathway as well as the void under outdoor pool deck, the air exchange could be allowed between north and south

Plate 7 Wind Flow Pattern of Prevailing North-Easterly Winds



4.2 Winds from Southern Sector

The two main directions of wind from southern sector are SW winds according to the summer data from both Tsueng Kwan O Weather Station and MM5, and the SE winds from Kai Tak Weather Station.

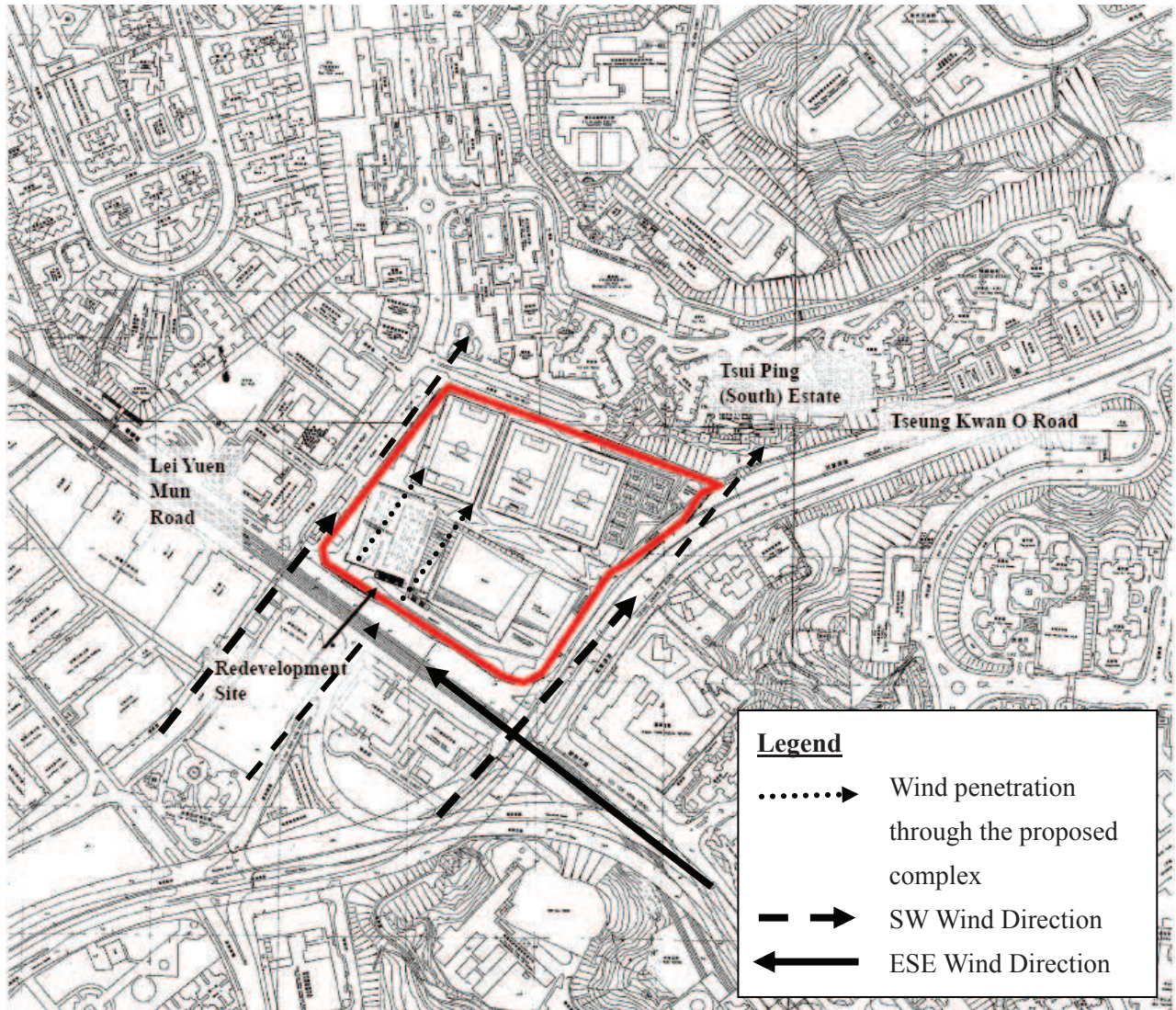
4.2.1 The major air-path at the south west of site, which refers to the nullah along King Yip Lane and rest garden, is not obstructed by the future development. Moreover the raised swimming pool deck of 5.5m from ground still offer pathway for wind penetration, especially south westerly during summer. The low rise nature of proposed complex allows wind to flow over the top and through the void of 3m vertical clearance at the hard-paved landscape area under the outdoor pool deck and reach the ground in a short distance. As mentioned in Section 4.1.4 above, an air pathway will be reserved is recommended at the crush hall to allow wind penetration.

4.2.2 The role of subject site offers a large open space within dense urban context and joining up with the nullah along King Yip Lane and Cha Kwo Ling Road to help local air ventilation particularly during summer with wind mainly from the southwest. The role could be maintained with the current layout design of proposed complex.

4.2.3 The existing MTR viaduct along Lei Yue Mun Road may slightly alter the wind flow pattern. However wind flow could still be allowed at pedestrian level under the viaduct. The raised and low rise outdoor swimming pool deck joining the nullah along King Yip Lane and the recommended air pathway at the crush hall joining Cha Kwo Ling Road could bring southwest wind into the proposed recreation ground.

4.2.4 Southeast wind penetrates into inner Kwun Tong district along Kwun Tong Road and Lei Yue Mun Road. As the proposed complex is a low-rise structure and locating alongside at Lei Yue Mun Road, significant impact on air flow from southeast is not anticipated.

Plate 8 Wind Flow Pattern from Southern Sectors



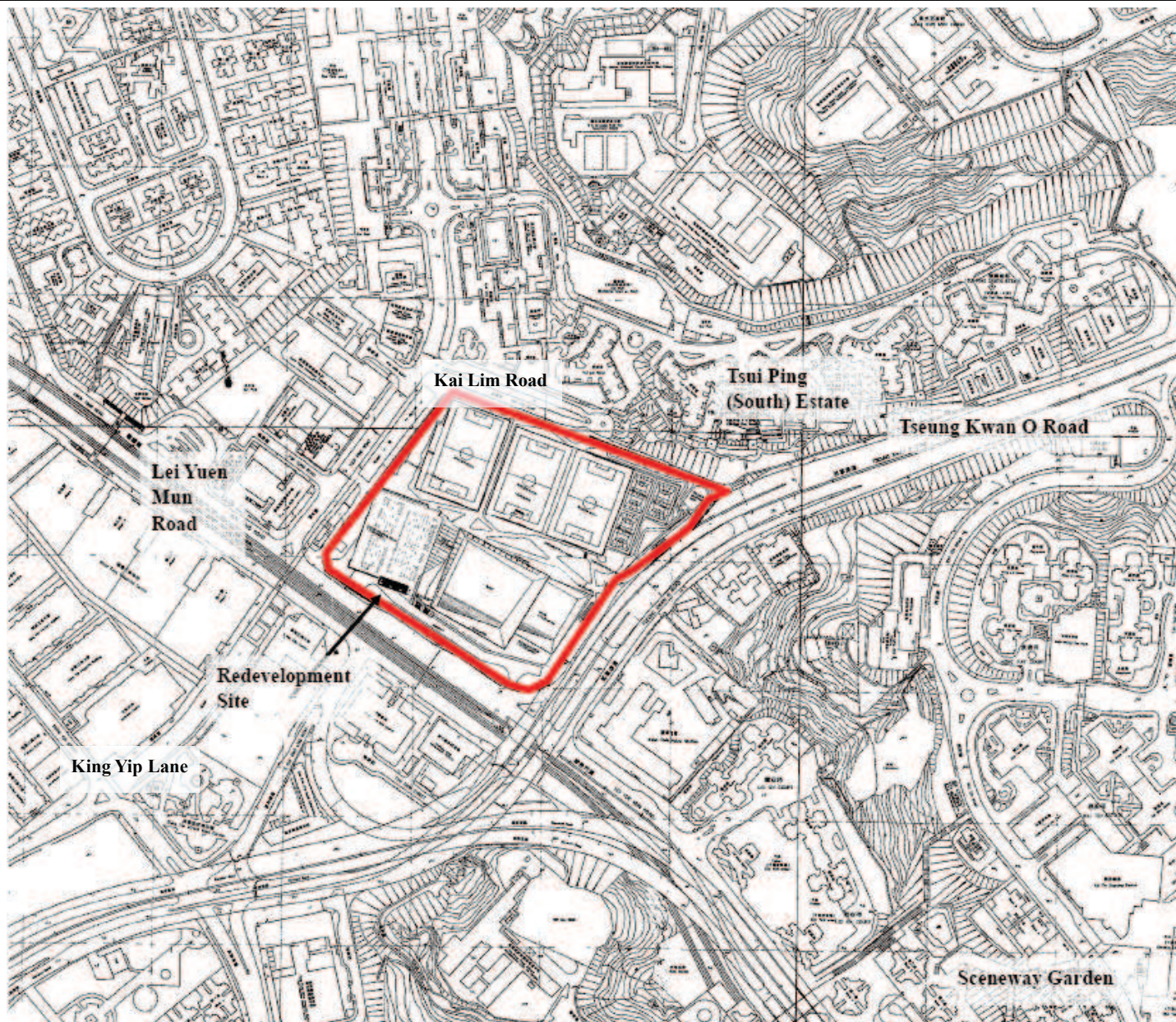
5. Conclusion

An Expert Evaluation has been carried out in accordance to ETWB Technical Circular No. 1/06 Air Ventilation Assessment (AVA) and Chapter 11 of the Hong Kong Planning Standards and Guidelines (HKPSG) for the purpose of air ventilation assessment. This report presents findings of Expert Evaluation.

There is no major obstruction of wind flow or significant air ventilation issues identified in general. Localised wind problem may occur at Lei Yue Mun Road when prevailing wind is from northeast and the inner recreation ground when wind is from southwest. The current design was developed with due consideration of potential air ventilation impact. The height of outdoor pool is only 5.5m above ground to minimise wind obstruction. A void of 3m vertical clearance at the hard-paved landscape area is provided under the

outdoor pool deck. An air pathway is recommended at the crush hall of the proposed Complex to allow wind penetration. Such design measures could allow the air exchange between north and south. Significant ventilation impact on Lei Yue Mun Road is not anticipated.

In general the proposed complex will have little specific wind problem. There will be no major air ventilation issue. Therefore, further study is not necessary.

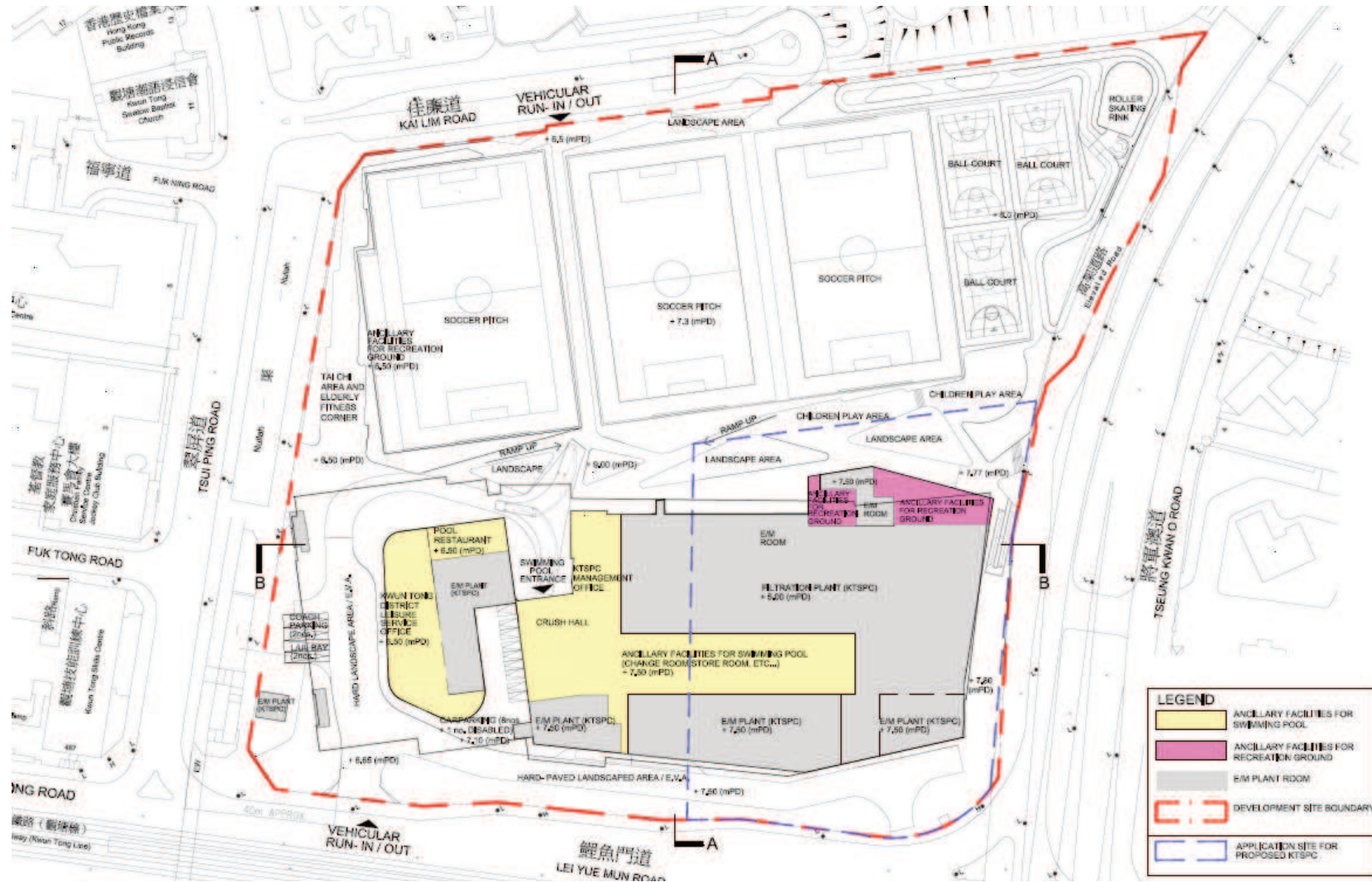


**THE REDEVELOPMENT OF KWUN TONG SWIMMING POOL COMPLEX AND RECREATION GROUND
 – AIR VENTILATION ASSESSMENT (EXPERT EVALUATION)**

Site Area

Figure No. 1	Rev. 0
Scale NTS	Date 03/09



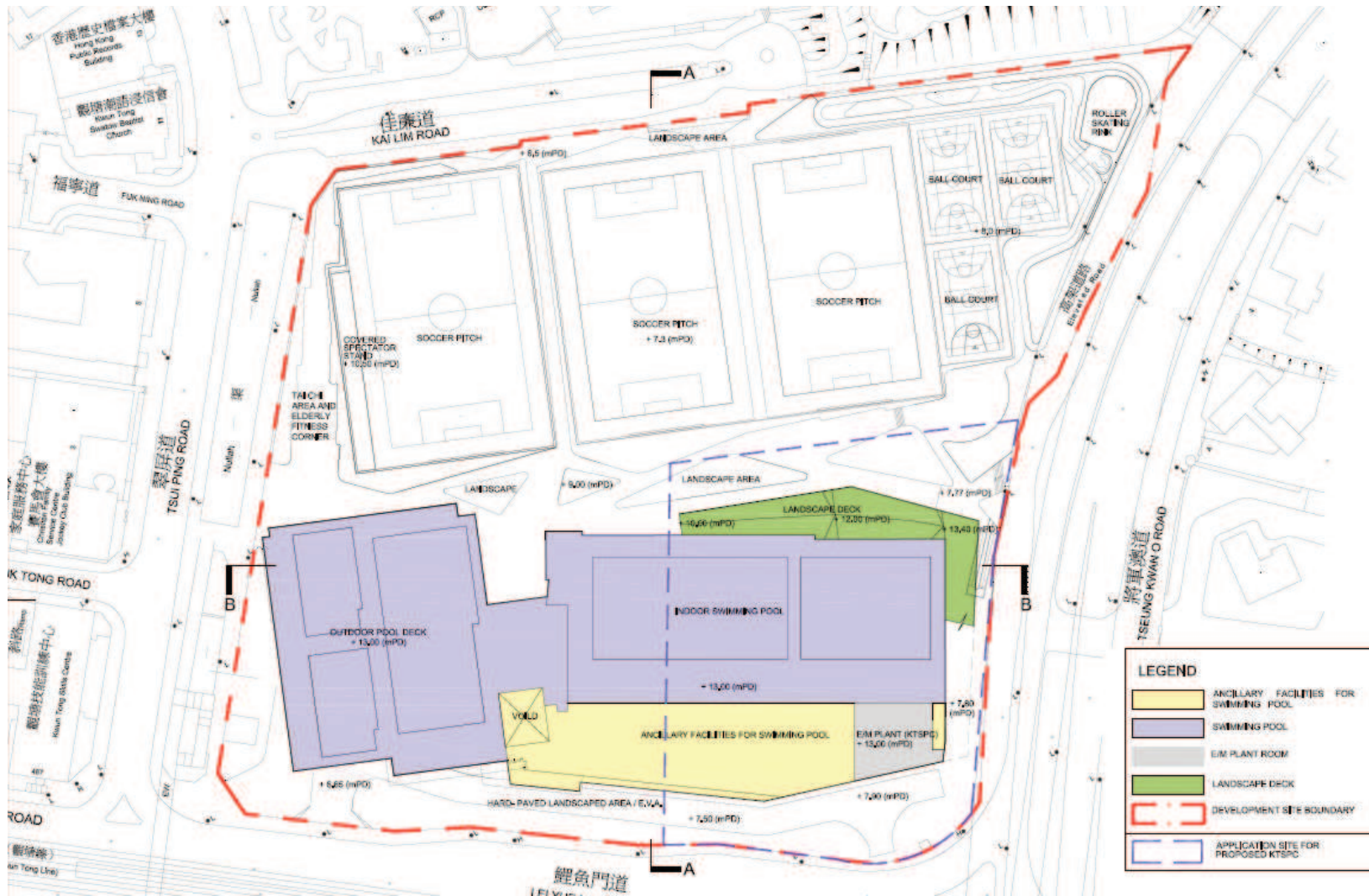


**THE REDEVELOPMENT OF KWUN TONG SWIMMING POOL COMPLEX AND RECREATION GROUND
- AIR VENTILATION ASSESSMENT (EXPERT EVALUATION)**

Ground Floor Layout Plan (Provided by RLP)

Figure No.	Rev.
a	0
Scale	Date
NTS	03/09



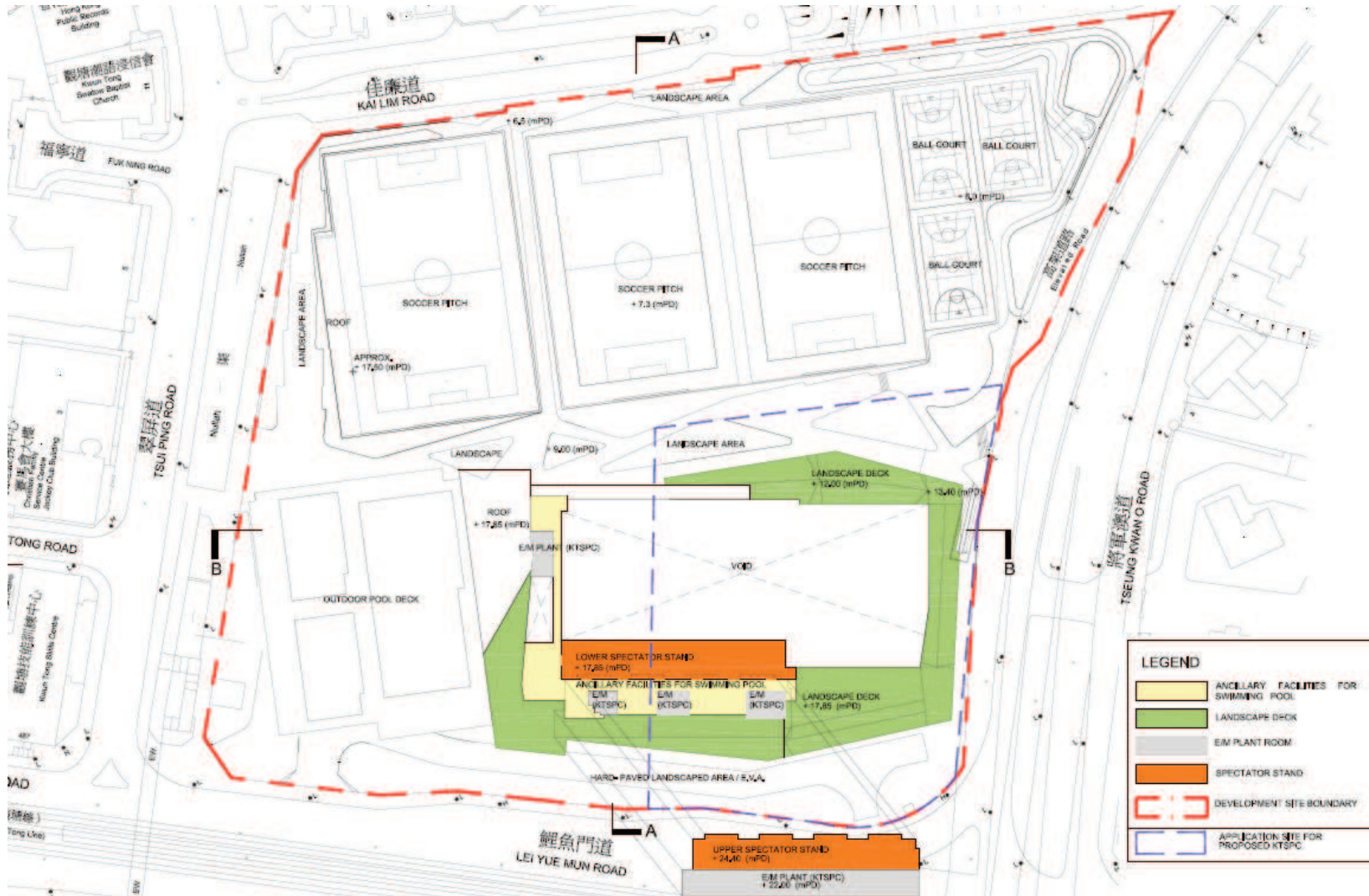


**THE REDEVELOPMENT OF KWUN TONG SWIMMING POOL COMPLEX AND RECREATION GROUND
- AIR VENTILATION ASSESSMENT (EXPERT EVALUATION)**

First Floor Layout Plan (Provided by RLP)

Figure No. □	Rev. 0
Scale NTS	Date 03/09



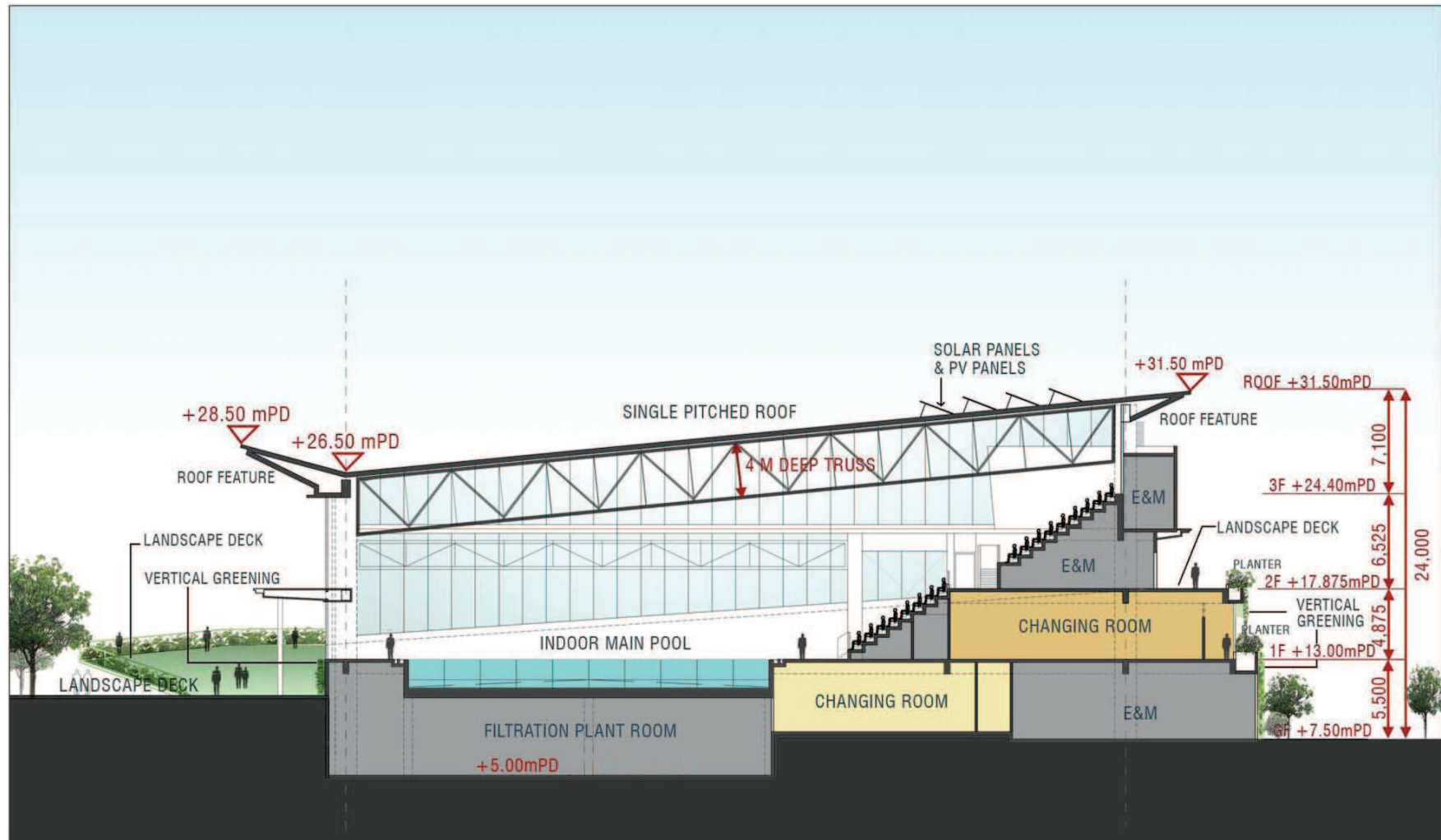


**THE REDEVELOPMENT OF KWUN TONG SWIMMING POOL COMPLEX AND RECREATION GROUND
 – AIR VENTILATION ASSESSMENT (EXPERT EVALUATION)**

Second Floor Layout Plan (Provided by RLP)

Figure No. C	Rev. 0
Scale NTS	Date 03/09



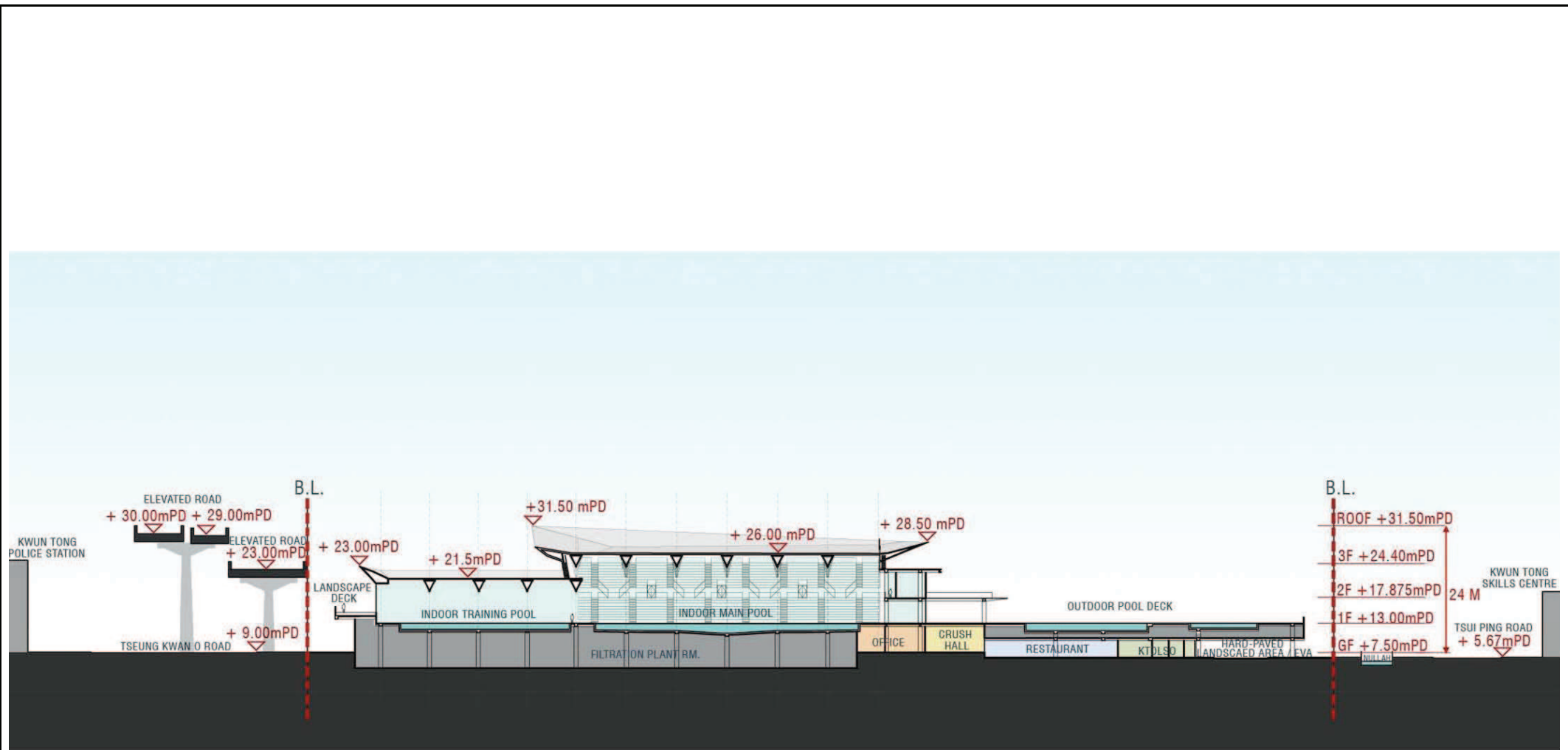


**THE REDEVELOPMENT OF KWUN TONG SWIMMING POOL COMPLEX AND RECREATION GROUND
 – AIR VENTILATION ASSESSMENT (EXPERT EVALUATION)**

Section Plan (Provided by RLP)

Figure No. □	Rev. 0
Scale NTS	Date 03/09





**THE REDEVELOPMENT OF KWUN TONG SWIMMING POOL COMPLEX AND RECREATION GROUND
 – AIR VENTILATION ASSESSMENT (EXPERT EVALUATION)**

Section Plan (Provided by RLP)

Figure No. e	Rev. 0
Scale NTS	Date 03/09

